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ABSTRACT

The Cognitive Enrichment Network (COGNET) Follow Through Project provides a community framework in which parents and preschool and primary grade teachers can help children learn. This report summarizes results of studies in a Tennessee school district on the impact of COGNET on children, teachers, and parents. The COGNET instructional model has three components: (1) mini-lesson plans; (2) a learning approach involving computer activities; and (3) a group dynamic assessment, which is used instead of assessment by traditional testing methods. Results of the studies indicated that children who had experienced 2 years of COGNET intervention showed gains over control children in Stanford Achievement Test reading and math scores; in motivation scores in the Maze Tasks of Intrinsic Motivation; and in cognitive functioning scores in a series of cognitive tasks. In their interactions with children, teachers used more positive behaviors, such as praise and reciprocity, after they received training for the COGNET program. Teachers with training exhibited more positive behaviors than a control group of teachers. Compared to other parents, parents participating in COGNET were able to give specific examples when solving problems, believed they could have an impact on children's learning, and reported that their children were enthusiastic about computers. A 13-item reference list is provided. (BC)

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COGNET

Cognitive Enrichment Network

COGNET FOLLOW THROUGH EDUCATION MODEL RESEARCH REPORT: STUDIES OF IMPACT ON CHILDREN, TEACHERS AND PARENTS, 1988 - 1991

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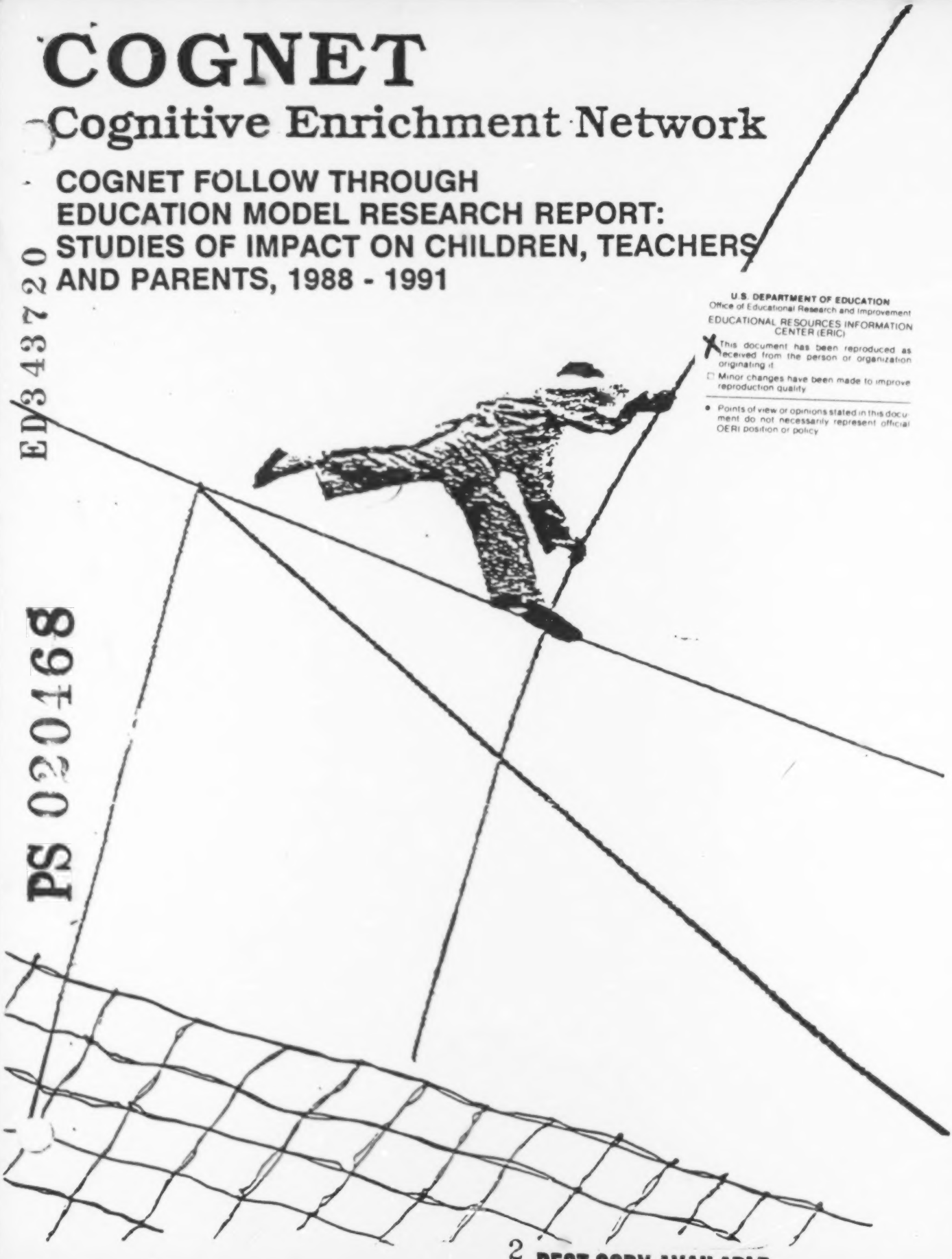

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COGNET FOLLOW THROUGH RESEARCH REPORT: STUDIES OF IMPACT ON CHILDREN, TEACHERS AND PARENTS, 1988 - 1991

Introduction

The COGNET Follow Through education model has a significant impact on recipients and implementers as demonstrated by the results of the studies summarized in this report. During the past three years we have documented the impact of COGNET's implementation as an integrated Follow Through education model. This report will summarize results of studies regarding impact of the program on children, teachers and parents, proposed reasons for observed effects, and future research plans to accommodate constraints on the studies conducted to date. First, however, this discussion needs to be placed in the context of the COGNET education model.

Description of the COGNET Education Model

The Cognitive Enrichment Network--Follow Through Project (COGNET), creates a framework within the community where regular, special and compensatory education preschool and primary grade teachers as well as participating parents work together to help children learn how to learn. As will be shown, the involvement of professionals and parents in a network committed to providing cognitive enrichment will significantly strengthen children's use of learning strategies that help them develop independent and effective learning behavior. Indeed, the compelling nature of the program is frequently reflected in children's comments.

The following are journal and letter entries (edited for spelling and meaning) from third grade children who participated in COGNET for less than one year:

> "I felt nervous and independent [about the achievement tests]. Independent means you can learn on your own."
>
> "I really liked [the achievement tests]. It was fun! I needed to use Feeling of Challenge and Working Memory.... They really help you in a hard situation. My feelings were a bit out of control, but I used Approach to Task...."
>
> "I was thinking about Self Development and thinking about what I can do better if I worked on it. After I thought about it, I knew that I can do division much better than I am doing it now. So I got a couple of pieces of paper and started to work on it. It was fun."

"My goal for today is to keep my name off the board. Self Development pays off."

A sizeable body of literature has documented the relationship between certain variables of adult-child interactions and cognitive development (see Lidz, 1987). At the same time, increasing evidence supports the effectiveness of the teaching of thinking skills to school age children (Segal, Chipman, & Glaser, 1985).

The COGNET education model is based on Feuerstein's theory of Mediated Learning Experience (MLE) which addresses, among other things, the sociological issues of low income and at risk families (Feuerstein, Rand, Hoffman & Miller, 1980). Indeed, Feuerstein and colleagues reported observations of adolescents living under stressful conditions resulting in unusually high levels of cognitive dysfunction, particularly when caregivers were unable to freely transmit cultural values.

According to the theory of MLE, children develop autonomous learning skills through social interaction guided by a mediator (including Head Start and primary school teachers, instructional assistants, as well as parents). In COGNET this mediation focuses on 18 key variables are termed "Building Blocks of Thinking" and "Tools of Independent Learning" (Greenberg, 1990a).

> For example, a mediator using the COGNET Building Block of "Approach to Task" helps children learn how to systematically gather information, make a plan for working, control their expression of thoughts and actions, and understand why these factors are important in learning.

The COGNET instructional model incorporates five well researched conditions which MLE facilitates (Perkins & Salomin, 1989). These conditions have been found to be crucial in helping learners transfer thinking skills as well as knowledge. These include the following:

> (1) showing learners how problems resemble each other, (2) directing learners attention to the underlying goal structure of comparable problems, (3) making learners familiar with the problem domains, (4) encouraging learners to formulate rules and relate them to examples, and (5) placing learning in a social context where justifications, principles and explanations are socially fostered.

In the **COGNET School Program**, our instructional model emphasizes an atmosphere where product is **not** disconnected from process and the classroom serves as a "laboratory for learning" where children assist one another in exploring approaches to

solving problems and understanding how to be successful in a given learning situation. In order to operationalize our model, three components are included in the COGNET program:

1. **Mini Lesson Plans--integrative curriculum materials designed to provide an understanding of Building Blocks of Thinking and Tools of Independent Learning.**

2. **TECHNET--a stimulating approach for cooperative learning involving computer activities that increase technological skills while emphasizing the need for testing theories.**

3. **Group Dynamic Assessment--a test/teach/test paradigm of assessment designed to provide a unique body of diagnostic information not available through traditional testing.**

Mini Lesson Plans assist school staff by providing basic information to share with children about the need for Building Blocks of Thinking and Tools of Independent Learning in specific learning situations and principles for their application. These integrative curriculum materials are intended to be used in conjunction with instructional activities selected by teachers and other educational staff. The Building Blocks and Tools become real to children as they discuss the effects of their own efficient or inefficient use in the present situation and then bridge to the need for them in other school, home, work and social settings.

TECHNET involves specific, empirically researched computer-based instructional activities (Shavelson, Winkler, Stasz, Feibel, Roby & Shaha, 1984). Software is integrated into the curriculum to emphasize both cognitive and basic skill goals. Computers are used in small groups, providing a collaborative atmosphere that research suggests reduces low--level errors and creates support for higher level thinking activities (Laboratory of Comparative Human Cognition, 1982). Through cooperative learning, opportunities are provided for peer oral explanations, elaboration of information being learned, personal reinforcement and feedback as well as peer accountability which, according to Male (1990), overcomes limitations of computers and individualistic learning. Guided by mediators, children interact with each other to connect events and build and test theories.

For example, in the simulation software called "Oregon Trail," children work in small groups to derive principles for decision making which determine the level of success in making it through crisis situations as they travel in a wagon to Oregon. Mediators facilitate discussions for all groups to determine what

a given group did that made their theory more or less successful than others.

Group Dynamic Assessment focuses on determining how children change their performance of novel as well as academic tasks when a test/teach/test paradigm is implemented. Group Dynamic Assessment is adapted from Feuerstein's well established Learning Potential Assessment Device (Feuerstein, Rand, & Hoffman, 1979). In the teaching phase generic learning strategy principles are mediated. Resulting scores can be compared across and within students to determine how each child performed during each phase as well as the degree to which each child benefitted from mediation. Consequently, we can target children for more intensive and individualized mediation of how to learn as a prerequisite for academic improvement as well as determine which children need more intensive and individualized instruction.

In the **COGNET Parent Program** parents learn to help their children become independent learners. Essentially, parents reinforce the school program by extending the network into home and job situations in a concrete and direct manner. Parents learn how to involve their children in discussions regarding how Building Blocks and Tools are needed in such daily activities as grocery shopping, selecting clothes to wear and in social and domestic relationships. They are provided with a Parent Activity Book containing ideas for how each Building Block and Tool can be mediated in given activities.

Parents are encouraged to become involved with the school program in a variety of ways. Each local project works with a Parent Advisory Board to determine how parents will participate in the school program. This board holds regular meetings to facilitate this effort. Some sites have opted for more intensive involvement of parents by planning to hire one or more to work part-time at the school with the specific job of helping all parents become more involved in Follow Through activities,

Subjects and Setting for these Studies

Utilizing established quantitative and qualitative techniques, we documented important changes in children, teacher and parental behavior. Participants for these studies were located in two communities in the same school district in a rural part of the Appalachian region of east Tennessee. While the two communities are similar in many ways, there are some differences. The demonstration site community is more rural than that of the control site community, it is smaller, has lower per capita spending, and a lower level of post secondary education for adults living in the community.

COGNET Follow Through Impact on Children

The theory of MLE which is at the heart of COGNET predicts that children who receive this type of intervention should become increasingly more independent learners, more able to adapt to new situations and more active generators of new information, rather than passive recipients. Therefore, COGNET made four claims regarding impact on children receiving the program: (1) COGNET children will make greater gains in basic academic performance than control site children, (2) COGNET children will make greater gains in display of intrinsic motivation than control site children, (3) COGNET children will display greater gains in behaviors related to effective cognitive functioning than control site children, and (4) COGNET children will display differences from control children in such factors as grade retention, attendance and referral/placement in special education.

The evidence for impact on children is based on our analyses of three dependent variables: (1) Stanford Achievement Test total reading and math normal curve equivalent scores, (2) Maze Tasks of Intrinsic Motivation efficiency scores, and (3) Cognitive Functioning Variables observational ratings.

The final analyses were based on the performance of 60 children. Approximately half of this group received a minimum of two years of intervention while attending the experimental group school. The other children were of the same grade levels and attended the control school. Sixty percent of all child participants at both schools were selected on the basis of low income (determined by criteria for Free and Reduced Lunch) and previous attendance at a Head Start or similar preschool program. Another 40% were selected by teachers on the basis of learning problems and low income needs.

Gains in Basic Academic Performance

Appropriate levels of the Stanford Achievement Test were administered to all children in the categories described above prior to implementation of the program in the fall of 1988. At the beginning of the second school year, the test was administered to qualifying children who were new to the school. Then, in the spring of 1991, the appropriate levels of the Stanford Achievement Test were administered to all experimental site children who had received a minimum of two years of intervention (those in first, second, third, and fourth grades) and a similar size group and grade level number of qualifying children at the control site for whom we had baseline scores. For purposes of analyses, Normal Curve Equivalent scores (NCEs) were used. (NCEs are normalized standard scores with a mean of 50 and a standard deviation of 21.06 and are recommended for use in research projects conducted with funds from the U.S. Department of Education.)

The results of analyses of Stanford Achievement Test scores are displayed in Tables 1 and 2 and Figure 1. The means of total reading as well as total math scores for experimental group children prior to program implementation were near the 36th percentile. The control group's mean scores were near the 50th percentile in both reading and math. After two years of intervention, the COGNET experimental group's mean scores improved to almost the 56th percentile for reading and more than the 64th percentile in math while the control group's average scores remained near the 50th percentile for both reading and math. In other words, the COGNET children increased on average 22.04 NCEs in math and 14.78 NCEs in reading while the control group's NCEs gain was .20 for math and -.94 NCEs for reading. When math and reading mean gain scores were compared simultaneously for both groups, the difference was significant (MANOVA, $p < .01$). Mean gain scores were significantly higher for the experimental group compared to the control group for both reading (t-test, 1-tailed, $p < .013$) and math (t-test, 1-tailed, $p < .001$). In order to factor out the differences in starting points of the two groups, Gap Reduction analysis was conducted and confirmed the validity of these highly significant differences.

Gains in Display of Intrinsic Motivation

The Maze Tasks of Intrinsic Motivation, a research tool developed at Vanderbilt University, measures the efficiency with which children complete mazes correctly as well as the degree of internal need to complete a greater or lesser number of mazes. Children were given instructions on how to accurately draw lines in mazes and a choice of terminating the activity after the first, second or third maze. The efficiency score was determined on the basis of the number of correctly drawn line segments, divided by the total possible correct line segments for the mazes completed, divided by the number of seconds the child took to complete one or more mazes. (Incorrectly drawn lines touch or cross a maze line, make a turn in the wrong direction, and/or stop and start due to the child picking up the pencil before completing the entire line for a given maze.)

Average efficiency scores on the Maze Tasks of Intrinsic Motivation were similar for both groups before COGNET implementation and were higher for the experimental group after two years of intervention than for the control group. (See Table 1.) Indeed, the mean gain scores were significantly higher for the COGNET group (t-test, 1-tailed, $p < .021$). (See Table 2.)

Gains in Behaviors Related to Effective Cognitive Functioning

Twelve tasks, varying in need for verbal, nonverbal, reasoning and general knowledge requirements, were administered individually to children in an approximately 10 minute time

period. Tasks administered to second and third grade children were similar but more complex than tasks administered to kindergarten and first grade children. Every qualifying child was video taped while completing the tasks prior to receiving the COGNET program as well as in the spring of 1991. Video tapes of these sessions were analyzed to determine the frequency of children's display of four efficient and four deficient cognitive functioning behaviors. (See Table 5 for definitions of the eight variables.) Observers rated the frequency of occurrence of each of the behaviors. Interrater reliability averaged 80.12 percent of agreement.

For the four efficient functioning behaviors, COGNET children's mean scores were higher in comparison to the control group after intervention. (See Table 3.) Significant differences were found between the groups on the combined variables for efficient cognitive functioning (MANOVA, $p < .016$). Specifically, the experimental group made significantly higher gains for "Seeks Clarification" (t-test, 1-tailed, $p < .049$), Affirms Statement" ($p < .045$), and Describes Plan ($p < .005$).

Parallel analyses of gain scores for deficient cognitive functioning variables examined in the same study indicated reduction in display of two of the four deficient behaviors for each group. (See Table 4.) There were no significant differences between groups.

Differences in Grade Retention, Attendance, and Referral/Placement in Special Education

Differences were measured in three "soft-sign" areas of grade retention and attendance. Numbers were too low for referral/placement in special education to determine differences.

The experimental school retained 10 children who were in the COGNET program while the control retained only one child. Criteria for and administrative policy regarding retention were, however, quite different at the two sites. In every case where COGNET children were retained, they made noticeable gains in classroom performance as measured by teacher grades and opinion regarding classroom behavior. Perhaps the reason the experimental group does not fit the national picture of negative effects of retention is that retention is not a social stigma in this and similar communities.

The mean differences between the experimental and control children was not significant during the first and second years of the study. However, the mean differences in absenteeism between the two groups was significant in a statistical sense (t test, 1 tailed = -2.340, $p = .020$). The experimental group had an average of 7.3 days absence and the control group and average of 8.95 absences.

COGNET Follow Through Impact on Teachers

Claims regarding impact of any intervention program utilized with children are dependent on the level of implementation of that program. Through daily/weekly teacher self reports, we have documentation that all trained teachers implemented the program components at a satisfactory or better level. Through the self reports we have a record of teacher implementation of COGNET program components including use of computers, cooperative learning and methods for teaching children how to learn. The heart of COGNET, however, is a particular type of adult-child interaction (MLE) which may occur at high levels for even untrained teachers.

Indeed, according to the theory of MLE the interaction behaviors are the proximal determiners of improved learning in children. Consequently, our claims about impact of the program are dependent upon more than level of implementation. These claims also are dependent on the relationships between those providing and receiving intervention. At the same time, we also must determine if our training procedures are effective in helping teachers interact with children in the classroom according to the principles of the theory of MLE. Our research efforts, then, have concentrated on examining changes in trained teachers and differences between trained and untrained teachers in the way they structure classroom interactions as well as their provision of MLE.

Twelve kindergarten through third grade teachers at the demonstration site and 16 at the control participated throughout the three years. Only one teacher subject at each site left a teaching position at the given school during the study. Staff at both schools were almost equal in the percent of teachers with masters degrees and the number of years experience in the classroom. Class size for teachers at each level were similar.

COGNET makes two claims regarding impact on teachers participating in the program: (1) COGNET teachers should be characterized after training as displaying a higher degree of MLE and a classroom structure based on dyadic interaction behaviors that are more closely related to the principles of the theory, (2) COGNET trained teachers should be characterized as displaying a classroom structure based on dyadic interaction behavior that is more closely related to the principles of the theory than untrained teachers.

Changes in Teachers Classroom Interaction Behaviors Before and After Training

We analyzed the middle five minutes of 10 minute video taped segments of classroom reading instruction. A pair of observers recorded a consensus rating for each variable. For purposes of

this study, observational analyses were conducted on video segments taped prior to training as well as a second set taped at the end of the second year for both demonstration and comparison site teachers. The observational analyses were conducted using two separate classroom interaction scales.

First, the quality of MLE displayed was determined using the Mediated Learning Experience Observational Analysis System developed by Greenberg (1990b). (See Table 6.) For nine of 13 MLE variables, observers recorded the highest level of mediation that occurred in each one minute segment. For four other variables, observers recorded an overall rating for each segment. Percent of agreement for interrater reliability for independent pairs of observers averaged 85 percent.

Second, in order to determine interaction behaviors related to classroom structure, we utilized one component of Brophy & Good's (1969) Teacher-Child Dyadic Interaction system which codes occasions in which the teacher interacts with children individually in situations where other children are expected to be listening. (See Table 7.) Essentially, this analysis system measures the type of teacher question, the child's response, and sustaining and terminal teacher feedback. Percent of agreement for interrater reliability of ratings for independent pairs of observers averaged 90 percent.

Correspondence Analysis, a geometric approach to multivariate descriptive data analysis rediscovered recently in France by Jean-Paul Benzecri (Greenacre, 1984), was used to determine the relationships between variables on both scales. This technique was selected because it allows simultaneous consideration of multiple categorical variables, can show how variables are related, and is good for discriminating individual differences among subjects.

Figure 2 displays the relationship between specific classroom interaction behaviors and each of 11 COGNET teachers before as well as after training. Each number in the figure represents a given teacher. We have added letters beside teachers' numbers in the figure in order to provide information about the level of MLE provided by given teachers as determined through observational analysis. The letter "A" represents the highest rating level and "G" represents the lowest level of provision of MLE. The point at the end of each arrow reflects a teacher's position after training. The base end of the arrow reflects a teacher's position before training. The additional codes reflect the position of various dyadic interaction behaviors and are defined in Table 7.

Nine teachers increased their level of provision of MLE with four teachers increasing by three levels, three increasing by one

level, and two increasing by two levels. One teacher remained at the same level and another decreased by one level.

Ten of the 11 teachers represented in figure 2 held a position in the third and fourth quadrants prior to training. Seven of these teachers moved to the first and second quadrants after training. Three other teachers moved in the direction of the first and second quadrants. One teacher moved slightly closer to other teachers but remained in quadrant I after training.

We are particularly interested in the movement towards quadrants I and II because the dyadic interaction variables that fell into those quadrants are precisely the behaviors which facilitate MLE while dyadic interaction variables behaviors positioned in quadrants III and IV represent behaviors which tend to interfere with provision of MLE.

Before training, teachers generally displayed characteristics which interfere with providing MLE. Questions asked required only short, recall answers or stating a choice for one given thing over another. Teachers most frequently called on children without giving them an opportunity to show a desire to respond. Children in general did not respond when the teacher called on them. Feedback generally was limited to providing answers.

In contrast, after training, seven teachers were characterized as asking questions requiring children to use higher level thinking. They gave children an opportunity to show a desire to respond or allowed them to call out answers. Children most frequently gave partially correct answers. Teachers were characterized as providing a variety of feedback including rephrasing the question or giving clues, telling children they were wrong, praising children, asking another child to respond and providing additional information.

The remaining four teachers shared similar characteristics after training including asking choice questions, receiving correct answers from children and providing feedback in the form of a new question. These characteristics tend to suggest a different type of lesson format than for the others.

Our claim that after training teachers would manifest a higher degree of MLE and dyadic interaction behaviors more closely related to the principles of the theory, is supported by these results. The behaviors characterizing most of the teachers after training are much more closely related to a classroom that creates an atmosphere of a laboratory for learning while prior to training these teachers frequently displayed very different behaviors. The laboratory atmosphere encourages mediated learning because children accept problems as opportunities for

gaining insight into learning and are not afraid to offer partially correct answers. However, we also needed to determine if trained teachers were different from untrained teachers.

Differences Between Trained Teachers and a Comparison Group

In order to determine whether trained teachers are characterized as displaying dyadic interaction behaviors that are more closely related to the principles of the theory of MLE than a comparison group of teachers, we categorized teachers from both groups based on their MLE observational analysis scores. Correspondence analysis was conducted on the data derived for both trained and untrained teachers. Figure 3 displays the relationship between specific dyadic interaction behaviors and teachers from both groups separately according to five levels of use of MLE (1 = Lowest Level and 5 = Highest Level).

Untrained, control group teachers could be categorized into MLE levels 1, 2, 3, and 5. Trained teachers could be categorized into MLE levels 2, 3, 4 and 5. Considering this data alone we cannot discriminate clearly between the two groups. Indeed, MLE is a naturally occurring phenomenon and varies in quality across any group of teachers. However, when we see the correspondence between trained and untrained teachers at each level of MLE and dyadic interaction behaviors we can find several differences.

Only trained teacher groups appear on the right side of Figure 3 and only untrained on the left side. Untrained level 3 teachers and Trained level 2 teachers are the only groups who share characteristics of dyadic interaction. In that case, the untrained teachers displayed a higher level of MLE than the trained.

In Figure 3 some codes appear in bold, indicating quality is greater than 35. This is important to note because a variable which has low quality is not well represented in the two dimensions or axes. Untrained teachers at the two lowest levels were generally characterized as asking questions requiring recall answers and calling on children without giving them an opportunity to show a desire to respond. These teachers provided a variety of feedback. In contrast, trained teachers at levels 3 and 4 generally asked questions requiring higher level thinking or requiring children to make a choice, allowed children to call out answers, and rephrased questions. The characteristics of the other groups of teachers cannot be explained by the axes represented in Figure 3.

These results support the claim that differences exist between trained and untrained teachers in the way they structure interactions in the classroom. In addition, a shared level of MLE for trained and untrained teachers does not result in shared characteristics. For the four groups of teachers where general

profiles can be determined, trained teachers displaying higher levels of MLE also display classroom interaction behaviors which are more in line with the principles of the theory than untrained teachers displaying lower levels of MLE.

COGNET Follow Through Impact on Parents

Claims regarding impact of the COGNET program are not limited to effects on children and teachers. Impact on parents is expected as well. COGNET makes two claims regarding impact on parents: (1) COGNET parents should report an impact of the program on both themselves and their children and (2) COGNET parents should display different attitudes than control site parents about their role in helping their children be successful in learning experiences.

Parents' Impressions of COGNET

Parents of children at the experimental school were asked a series of questions about the COGNET program and their perceptions regarding its effects on themselves personally as well as on their children. According to the parents interviewed, COGNET made an impact on their lives personally as well as on the lives of their children.

COGNET parents stated that the program helped them understand their children. It helped them work with their children in both school related and home related activities and problems. It also helped them "understand what teachers are doing at school." They reported that COGNET influenced their children. "It makes it (school) more interesting and she loves challenges that the teacher gives so well." COGNET has also made school "easier." Parents believed as well that COGNET made the teachers better teachers. "I see a difference in the teachers that use COGNET training." Also, according to these parents, COGNET helped them by making support services, such as medical and dental services, available. "It has helped to get a lot of dental work done."

The parents reported using the Building Blocks of Thinking and Tools of Independent Learning that they learned in their COGNET training. Indeed, the parents who received training used the actual terms for the Building Blocks and Tools when they talked about their children and the learning process. They mentioned many times the importance of "completing the task" and "the importance of making a plan." They described using the Building Blocks with special problems such as "taking control of your actions and slowing down to complete homework." One parent described using the Building Blocks with her child and "his special problem." She "reinforces the Building Blocks at home." Parents were also glad that they were familiar with school terms and "could apply them" at home.

All parents stated that they had used the Parent Activity Book that had been provided them during COGNET Parent Workshops. One parent used it from the beginning. Other parents mentioned using it for grocery shopping, cooking, learning to make a bed, planting flowers and vegetables. Another stated that "COGNET helps with math." Parents reported that they used COGNET also in making a plan before starting a task.

The parents gave very specific examples of how they used the Parent Activity Book. One parent discussed making a plan for gardening and then discussed in detail the elements of the plan. She stated it is necessary to understand "the importance of preparing the soil and planting the seed, watering and keeping the weeds pulled out." Another parent stated, "I find the Building Blocks very helpful in every day living."

At the conclusion of the parents' involvement with the COGNET project, they reported only positive experiences. For some their first contact with the project, a letter from the school, was not so positive. Many were "doubtful" and several were "doubtful of the success, but were willing to give it a chance." Others were "excited" and "willing to try it" from the outset.

Those who were involved in the parent training felt that all components of the program were beneficial. They spoke of the success of the COGNET Parent Workshops and talked about how it changed their understanding of school and their interaction with their children. They also believed that the program "should continue to provide the medical and the dental services." Several of the parents mentioned that "we could have not afforded" these services otherwise. For parents who did not participate in the parent training, the services were of most importance. However, many of these parents wished later that they had participated in the parent training.

Parents were enthusiastic in their support of COGNET. They wished that they could continue with the program hoping for a "COGNET II" so that they "could continue on to learn more until there is nothing else to learn." They believed that "all grades should have it" and that "it should be in every school in the state." They recommended to other parents to "sign up in a minute," and stated that they would tell other parents "it is the most worthwhile time you can spend for your child and yourself." One parent summed up the parent reactions very nicely, saying COGNET "brings you to your child's level and shows you how to handle the child's problem without doing it for them. It lets you see your child grow and you grow with them."

Differences Between Experimental and Control Parents

Differences were observed between those parents of children receiving COGNET and those not receiving COGNET. The parents of COGNET children responded differently than did the parents of control students concerning why they wanted their children to go to school, how teachers should approach a task, and if parents make a difference in how their children learn. They also explained before school, afternoon and evening routines differently. In addition, they had differing descriptions of how they helped their children with problems and what kind of new learning situations their children had experienced.

1. Both COGNET and non-COGNET parents wanted their children to go to school to receive a good education and to learn to get along with others. COGNET parents, however, also connected going to school with the possibility of "good employment" and associated school with jobs.

2. The COGNET parents reported their children's enthusiasm for working with the computers. This was a common element in all the responses. The non-COGNET parents did not discuss the use of computers and did not have a common element in the responses. They told of their children discussing "new words" learned in reading and "telling how they play games."

3. When asked if and how teachers should get children to think about ways to approach a task, the COGNET parents provided more specific information about things that teachers could do such as "discuss the task," "give the children time to think," "give examples," "be with them every step," and "teach them to organize." While the non-COGNET parents did not discuss steps in specific detail, they did stress the importance of "knowing the end product" and providing motivation.

4. COGNET parents believed that parents can really make a difference in how their children learn. They discussed specific ways that they could help, including techniques of helping and ways of motivating. Some of the non-COGNET parents suggested specific ways, but also responded "not without training" and "parents can make a difference - I don't know that they do."

DISCUSSION

The results of the studies we completed in the first three years of COGNET Follow Through reflect a highly positive impact on children, teachers and parents. The program met needs of the community in which the research took place. We believe there are two overall explanations for this success: (1) the linkages that occur within and across the Follow Through program and (2) our

use of a coherent approach based on a valid theory. This section of the research report will discuss each of these explanations as well as constraints on the studies.

Linkages

The federal government has created a dynamic, nationwide laboratory for educational change and innovation in Follow Through. The National Follow Through network of sponsors and schools provides visible solutions to diverse educational problems and practical tools for applying these solutions in communities everywhere. What is responsible for this success? We believe that the answer lies in linkages--in collaborative efforts and the sharing of expertise among researchers, curriculum development specialists and those on the line in local schools as well as parents who truly know the whole child. Follow Through models are effective because they design and implement programs under real conditions. As a result, Follow Through can provide answers to critical questions facing local and state education agencies throughout the nation.

COGNET has become a part of a linkage that allowed the model to benefit from 24 years of Follow Through experience in bringing about substantial and lasting improvements in the ways schools educate young children. Indeed, all Follow Through models are strengthened by a shared vision of not just where we need to go but how to get there. For example, at one of the National Follow Through Association's meetings 15 Parent Involvement Coordinators, most of whom had been a part of Follow Through for more than 20 years, shared proven methods for effective parent involvement. As a result, it was not necessary for COGNET to reinvent the wheel. Instead, local educators took these ideas and adapted them to meet the needs in their own communities and applied them to our education model.

Follow Through believes linkages are crucial if we are going to meet the needs of today's children. In fact, we believe they are responsible for the proven effectiveness of a wide range of Follow Through education models. These linkages occur at many levels, including within each model.

The Follow Through program creates a unique three-way partnership of local and state educators, research and program development sponsors, and parents who work together for program improvement. Grants are awarded to local education agencies in partnership with grants to research institutions which serve as sponsors. As a result, researchers and communities have been able to bridge the gap between educational theories and research findings on the one hand and practical educational services to children and families on the other.

Through this linkage, school staff and sponsor staff work together to design, test and prove the effectiveness of specific education models with real children, parents, and educators all over the United States in urban and rural settings, on Indian Reservations and in bilingual communities. In the COGNET Follow Through model, Support Teachers and Social Workers from each demonstration site meet together regularly with Sponsor staff. Each practioner shares his or her successes as well as problems and offers encouragement and ideas for refining various practices. Sponsor staff facilitate this process while sharing successful methods used in other schools implementing our model and guiding discussions to assure that the underlying belief system of the model is not lost as methods of implementation are refined.

Based on linkages with teachers and administrators implementing COGNET, we found that many teachers needed to change the types of activities in which they engage their students. It is difficult to learn how to learn when you are most frequently being asked recall level questions. As these teachers gained an understanding how one become's an independent learner, they wanted to change the activities in their classrooms but did not know how. As a result, we added cooperative learning and a set of procedures for integrating computer problem solving activities into the COGNET model. We have found that the learning to learn concepts of the program enhance the cooperative learning and computer activities as much as they create an atmosphere that assists children in operationalizing the learning to learn concepts.

Parents are a critical member of the three way linkage. A basic belief of Follow Through is that parents have both the right and responsibility to share in their children's education. As a result, parents are decision makers, teachers, and advocates in the education of their children. They participate on Parent Advisory Boards, making decisions about the nature and operation of the project. They build community support for the Follow Through program. They participate in workshops to learn how to reinforce classroom instruction with their children at home, to learn how to assist as volunteers or paraprofessional aides in Follow Through classrooms, and to gain knowledge about community services, career opportunities and basic parenting skills.

COGNET also benefits by sharing three service components with all Follow Through models. Today, most education reformers are calling for inclusion of all three if we are to truly meet the needs of children at-risk. They include the following: (1) a comprehensive full-day instructional program for the regular classroom that focuses on prevention rather than remediation; (2) comprehensive health, social, nutritional and psychological services for qualifying children and family members, including literacy and basic education so that we can

serve the whole child; and (3) parent involvement activities that enable parents to take part in their children's education and participate in decision making about the communities' Follow Through Program.

In addition, COGNET incorporates six critical variables for effective program improvement which have evolved through 25 years of Follow Through efforts. They include the following:

1. A coherent educational approach based on a valid theory or belief system.

2. Documentation of methods and careful study in a variety of settings.

3. A training system which assists in transfer of the approach and helps staff with implementation.

4. A monitoring system to determine level of implementation.

5. An assessment system of child outcomes to evaluate the results.

6. Active parent involvement.

These variables allow developers of education models to form more careful linkages with local educators and assure success of programs. Perhaps the least well understood variable is the first. The COGNET program is a good example of why it is important to base educational programs on a valid theory or belief system, particularly when dealing with the problems in America today.

Use of a Coherent Approach Based on a Valid Theory

In teaching children how to learn, COGNET focuses on the role culture plays in cognitive development. Many American students do not appear to be able to learn as they should. The problems are almost certainly related, at least to some degree, to alienation between teachers, students, parents and their respective cultures. In other words, the perceived needs of society and the real needs of children are in conflict and bear directly on the dynamic system between teacher and students. The data on performance of students by race/ethnicity clearly points this out. (See the Nation's Report Card, 1989). But culture and alienation and learning problems are immense subjects.

In order to assure success in programs dealing with such problems, it is crucial that we rely on theories which accommodate central aspects of the problem. The theory of MLE which underlies COGNET is sensitive to the effects of culture,

cultural alienation, and the dynamic system of adult/child interactions on learning.

We can observe MLE through the traditional practice of Navajo grandparents when they decide to teach their grandchildren how to make a basket. They help the children discriminate among plants and to choose the appropriate yucca plant. Then, over perhaps 12 days, they teach the children how to shred the yucca plant into strips, how to bend the strips into place, how to follow the traditional rules for coiling and making the design of the basket. As they teach, they question the child about the rules for basket making, pointing out that the reasons behind the rules relate directly to Navajo beliefs about the world and one's connectedness to it. As the grandparents guide the interaction MLE occurs and, as a result, children gain a new level of understanding and over a period of time build a new, enlarged needs system. Contrast this with the approach of a single parent with little money and much stress--where the focus is only on the final product and children receive no help in understanding why and how things are done in their culture.

The example demonstrates a high level of naturally occurring MLE. However, if this mediation is based on values different from those at school, alienation can occur between teacher and student. In other situations, when parents and/or grandparents lose touch with cultural values, they do not provide the quality of MLE needed for children to become effective learners. When children from these families enter mainstream culture schools they do not respond as teachers expect and alienation often occurs.

Through understanding of the theory of MLE, we can explain why cultural alienation often results in learning problems. As a result, we were able to develop a coherent program which deals with every aspect of this problem. Our goal is to help teachers and parents understand the importance of pride in one's own culture and respect for the culture of others. At the same time, we have developed methods for explicitly teaching children how to learn through the use of focused MLE so that they can reach a level of independent learning that otherwise might not occur. Without a coherent theory underlying our model, we would be floundering in the dark and guessing at how to overcome this problem.

The results of these studies offer powerful encouragement to continue research on the COGNET education model. Some constraints on these studies, however, indicate new directions for future research.

Constraints

Our present studies did not allow us to determine which of the program components actually are responsible for the impact we observed on children. We cannot state yet the relative importance of health and social services nor explain how the TECHNET computer/ cooperative learning activities integrate with the basic program. The research studies completed on teacher changes, however, indicate that the classroom structure was a key difference between experimental and control classrooms, regardless of specific activities implemented. The research study completed on parents tends to reinforce the impact of the focused MLE program.

Although every effort was made to assure independent, blind collection of data, this was not possible in every situation. Teachers were involved in test administration, for example. Research assistants were aware when they were in the experimental versus the control school. However, observational data analyses as well as hand scored tasks were conducted in a random fashion with subjects from both sites mixed together.

Perhaps the most serious need in future studies of the COGNET education model is to include a much larger number of subjects as well as a wider variety of ethnic groups and types of school settings. If the impact of COGNET documented in this report can be generalized across such variables, then we will have demonstrated the importance of the theory of MLE in meeting the needs of at-risk children in today's schools.

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TABLE 1. MEANS AND STANDARD DEVIATIONS FOR READING, MATH, AND MAZE TESTS

VARIABLE		CONTROL GROUP PRE	POST	GAIN	EXPERIMENTAL GROUP PRE	POST	GAIN
Stanford Test							
Reading	N	29	29	29	29	30	29
	$\bar{X}$	49.63	48.68	-.94	39.11	54.04	14.78
	SD	15.41	18.99	18.85	19.15	13.91	17.82
Math	N	29	28	28	29	30	29
	$\bar{X}$	50.17	50.10	.20	39.36	60.82	22.04
	SD	16.64	16.58	18.66	21.57	19.03	23.90
Maze Test	N	23	23	23	40	40	40
	$\bar{X}$	.003	.010	.006	.005	.020	.015
	SD	.008	.015	.014	.008	.021	.017

NOTE: Means and Standard Deviations of Reading and Math were calculated from normal curve equivalents. Means and standard deviations of Maze tasks were from raw scores representing efficiency indices.

TABLE 2. RESULTS OF T-TEST, MANOVA, AND GAP REDUCTION ANALYSIS FOR GAIN SCORES FROM READING, MATH, AND MAZE TESTS

VARIABLE	T-TEST	MANOVA	GAP REDUCTION
Reading	$t(56) = 2.281$ $p < .013$	Wilks' Lambda = .780	.965
Math	$t(56) = 3.264$ $p < .001$	$F(2,54) = 7.629$ $p < .001$	1.296
Maze	$t(61) = 2.074$ $p < .021$	-	-

NOTE: Maze Test was not included in MANOVA. Gap reduction analysis was not performed for the Maze tasks.

TABLE 3. MEANS AND STANDARD DEVIATIONS FOR EFFICIENT AND DEFICIENT COGNITIVE FUNCTIONING VARIABLES

		CONTROL GROUP			EXPERIMENTAL GROUP		
VARIABLE		PRE	POST	GAIN	PRE	POST	GAIN
EFFICIENT FUNCTIONING							
Voluntary Comments	$\bar{X}$	.78	2.48	1.70	1.60	3.15	1.55
	SD	1.09	3.99	3.39	2.38	3.96	3.82
Seeks Clarification	$\bar{X}$	.96	.57	- .39	.68	1.08	.40
	SD	1.22	.99	1.47	1.40	1.53	1.96
Affirms Statement	$\bar{X}$	14.04	14.87	.83	14.85	18.42	3.58
	SD	4.93	3.81	4.62	4.15	6.49	6.80
Describes Plan	$\bar{X}$	2.22	4.61	2.39	1.92	6.48	4.55
	SD	2.17	2.78	3.46	1.70	2.50	2.77
DEFICIENT FUNCTIONING							
Off Task Behavior	$\bar{X}$	.70	1.13	.43	.45	.23	-.23
	SD	1.52	3.75	3.31	.93	.73	1.14
Impulsive Behavior	$\bar{X}$	.52	.91	.39	.38	.68	.30
	SD	1.16	1.41	1.44	.67	1.07	1.29
Failure To Respond	$\bar{X}$	3.87	3.30	- .57	2.65	3.20	.55
	SD	5.40	4.13	4.29	2.93	4.12	4.56
Don't Know Response	$\bar{X}$	5.43	3.00	-2.43	2.80	2.53	-.28
	SD	6.75	2.66	6.21	3.05	2.05	3.43

TABLE 4. RESULTS OF T-TEST AND MANOVA FOR GAIN SCORES FROM EFFICIENT AND DEFICIENT COGNITIVE FUNCTIONING VARIABLES

VARIABLE	T-TEST	MANOVA
EFFICIENT FUNCTIONING		
Voluntary Comments	$t(61) = -.152$ $p > .440$	Wilks' Lambda = .813 $F(4,58) = 3.340$ $p < .016$
Seeks Clarification	$t(61) = 1.682$ $p > .049$	
Affirms Statement	$t(61) = 1.721$ $p > .045$	
Describes Plan	$t(61) = 2.714$ $p < .005$	
DEFICIENT FUNCTIONING		
Off Task Behavior	$t(25) = -.924$ $p > .183$	Wilks' Lambda = .903 $F(4,58) = 1.556$ $p > .198$
Impulsive Behavior	$t(61) = -.26$ $p > .398$	
Failure to Respond	$t(61) = .955$ $p > .172$	
Don't Know Response	$t(29.9) = 1.539$ $p > .067$	

TABLE 5. DEFINITIONS OF EFFICIENT AND DEFICIENT COGNITIVE FUNCTIONING VARIABLES

VARIABLE	DEFINITION
Efficient Functioning Voluntary Comments:	Child makes unsolicited references to his/her performance
Seeks Clarification:	Child asks questions related to request for performance
Affirms Statement:	Child is responsive to statements about the process involved in performing
Describes Plan:	Child makes a statement regarding the process used to complete the task
Deficient Functioning Off Task Behavior:	Child engages in activities which reflect lack of attending to the task and/or administrator
Impulsive Behavior:	Child begins task before administrator completes instructions
Failure to Respond:	Child does not perform task and/or answer questions asked by administrator
Don't Know Response:	Child shrugs shoulders or states "I don't know"

Table 6
Mediated Learning Experience and Question Dyad Interaction Variables for Analysis

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Mediated Learning Experience Variables for Analysis

Intentionality - the degree to which the mediator deliberately guides the interaction in a chosen action.
Contingent Responsivity - the degree to which the mediator responds verbally or nonverbally to the children's behavior in a timely and appropriate manner (Lidz, 1989).
Transcendence of Domain Specific Knowledge - any transcendent connection between the content of the given domain and the content of some other domain.
Subjective Meaning - any verbal expression of a degree of worth that exists in the mediator's mind.
Affective Meaning - any nonverbal expression of affective engagement of the mediator with the children (Lidz, 1989).
Mediation of Self-regulation - any means the mediator employs to assist children in controlling their approach to a given activity.
Transcendence of General Strategic Knowledge - any transcendent connection between the given domain and cognitive processing of that domain.
Objective Meaning - any verbal expression of a degree of worth or significance in which a connection is made to actual features and characteristics of some aspect of the domain.
Task Regulation - the quality of intervention provided by the mediator to a child who displays difficulty in the given situation (Lidz, 1989).
Praise/Encouragement - the quality of comments made by the mediator to inform children that their performance was good (Lidz, 1989, adapted).
Mediation of Goal Directedness - the degree to which the mediator helps children think in terms of a goal or purpose (Lidz, 1989, adapted).
Reciprocity - the level of receptivity of the child to the mediational intentions of the mediator (Lidz, 1989).
Level of Thinking Elicited from Children - the degree of higher or lower level thinking required from the children as they respond to the mediator's intent.

Table 7
Question Dyad Interaction Variables for Correspondence Analysis

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Response Opportunities - public moments in which the child answers a question asked by the teacher. There are four types of questions that the teacher may ask.

CDR Direct Question - when the teacher asks a question of a child who has not sought the opportunity to respond.
CDP Open Question - the teacher asks a question, waits for students to indicate a desire to respond, and then calls on a student.
CCA Call Out - when a child not called upon calls out an answer.
NCC Number of Children - how many children with whom the teacher interacts.

Level of Questions - the type of response demand that is presented to the student. It refers to levels of questions and types of questions.

QPC Process Questions - require the child to apply, analyze, synthesize, or evaluate.
QPR Product Questions - request a single answer that is short and uncomplicated.
QCH Choice Question - the child is given the opportunity to choose between responses when asked.
QSE Self-Reference - provides the student the opportunity to describe personal preferences and experiences.

Child's Answer - this measures the correctness of the child's response.

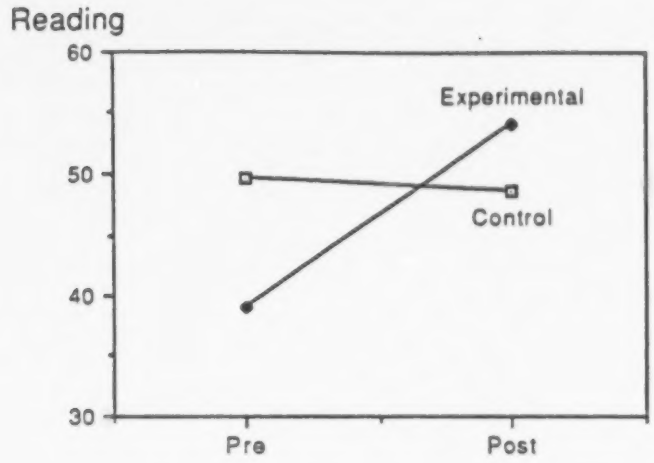
APO Correct Answer - child answers to satisfy the teacher.
APN Part Correct - the answer is correct but it is not complete.
ANE Incorrect Answer - the teacher responds as if the answer is wrong.
ANR No Response - child does not respond.

Terminal Feedback Reaction - this unit scores the teacher's feedback reaction that ends the unit of interaction.

FPP Praise - teacher evaluation of answer beyond simple affirmation.
FAF Affirmation of Correct Answers - teacher indicates that response is acceptable.
FO No Feedback Reaction - teacher does not respond to the child.
FNW Negation of Incorrect Answers - simple feedback that answer is wrong.
FPC Process - provides additional information concerning the question or response.
FGA Gives Answer - tells the child the answer.
FAO Asks Other - requests another child to respond to the question.
FCA Call Out - another child call out the answer.

Sustaining Feedback Reaction - designed to continue interaction with the child.

SRE Repeats the Question - allows the child the opportunity to respond again.
SRC Rephrase or Clue - helps the child with a second response.
SNE New Question - continues the dialogue.



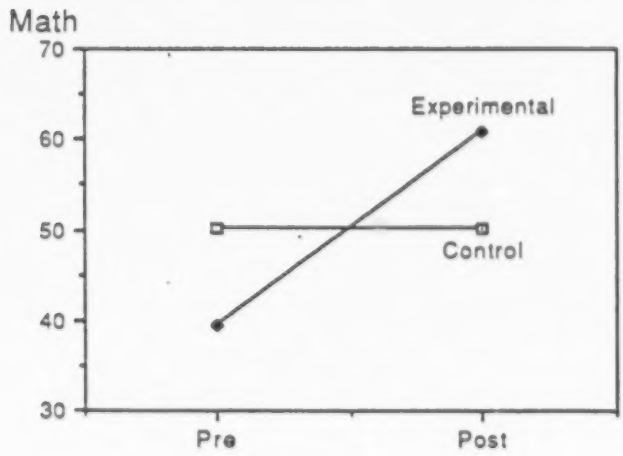


Figure 1. Pre and post Stanford Achievement Test scores for control and experimental group children.

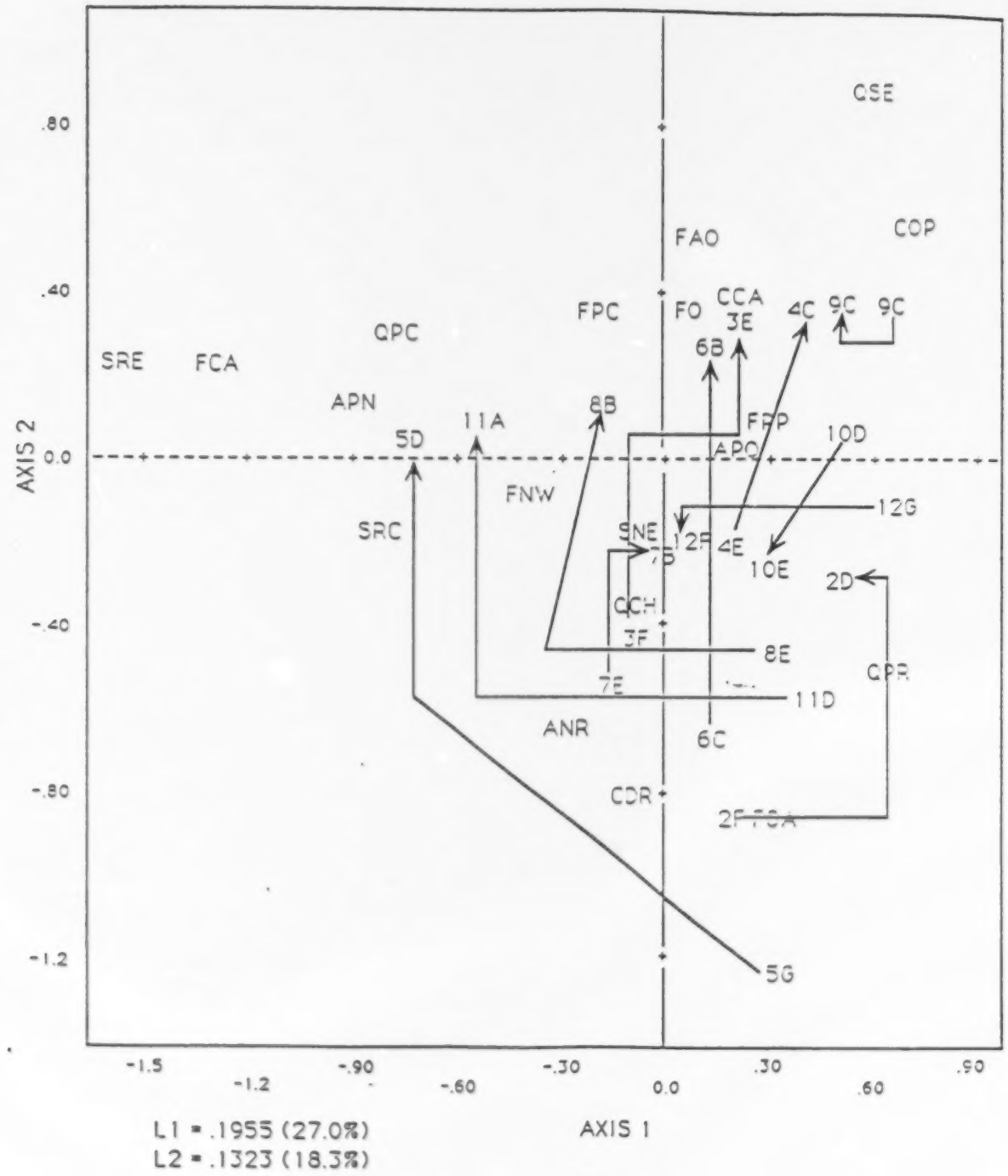


Figure 2. Teacher's use of Mediated Learning in relation to Question Dyadic Interaction Behaviors before and after training.

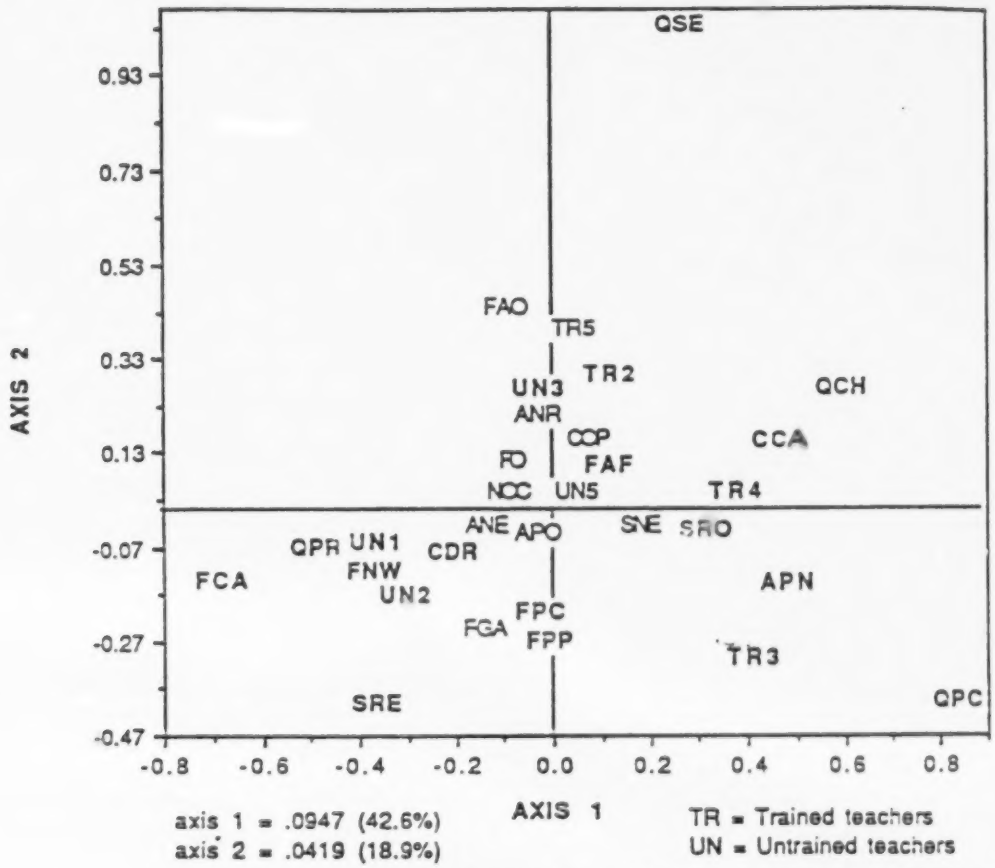


Figure 3. Correspondence between level of MLE and Question Dyad variables

Note 1: Bold face means quality is greater than .35.
Note 2: See Table 2 for definitions of question dyad variables coded in this figure.